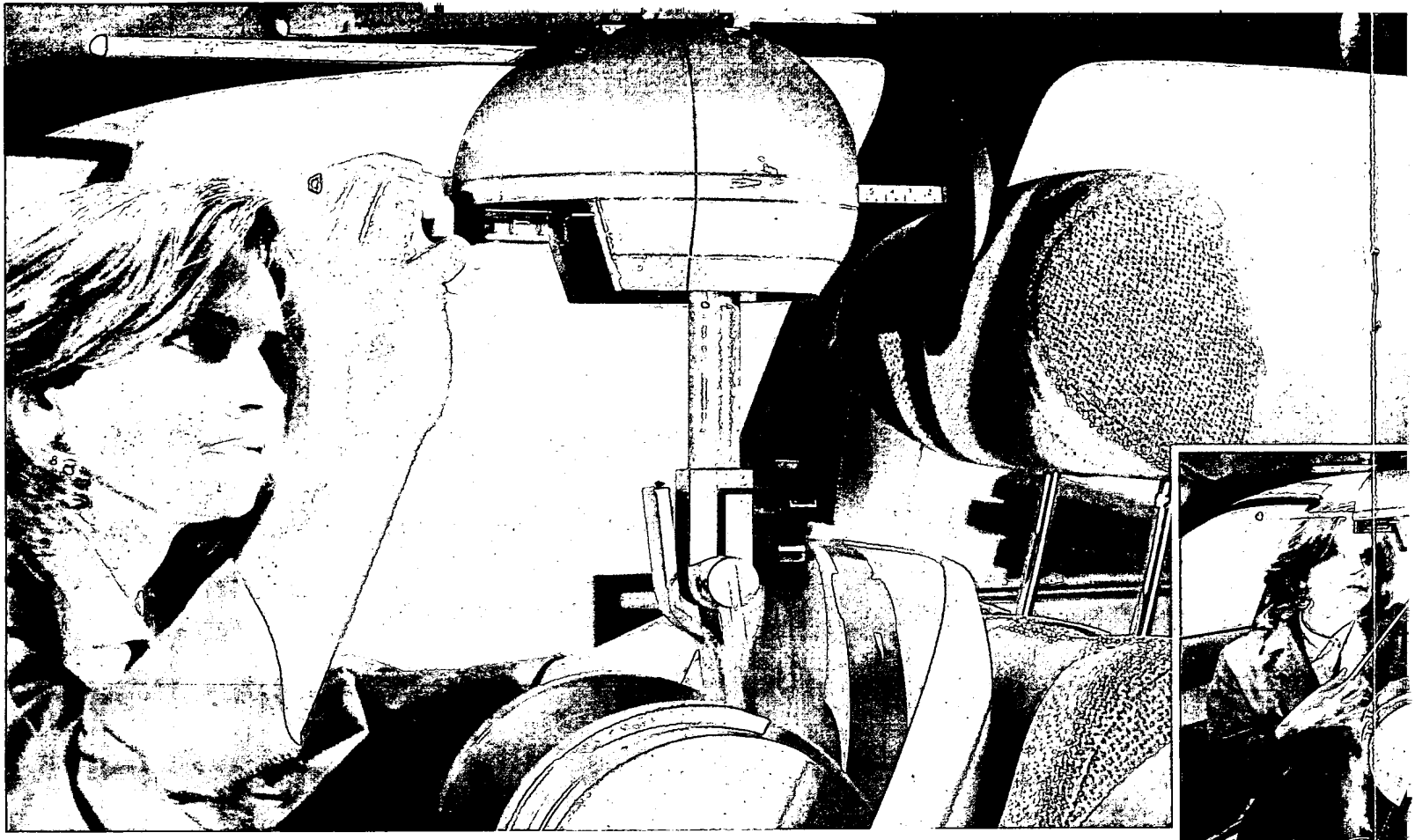


How Bad Are They?

Best Head Restraints Are in Volvo Models; Restraints in 117 of 164 Cars Rat

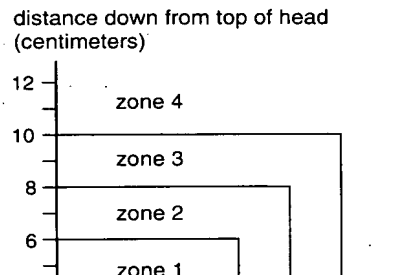
Head restraints are supposed to keep motorists' heads from being snapped back in rear-end crashes. But many people in all but a handful of 1995 car models aren't reaping this benefit.

Institute researchers evaluated the geometry of head restraints in 164 car models, judging the restraints in only 5 good. In contrast, the restraints in 117 models — 71 percent — are rated poor. The other 42 cars have acceptable or marginal head restraints.

Twenty-seven of the 164 cars, all 1995 models, have fixed head restraints instead of adjustable ones. In general, the fixed kind should be better because it doesn't depend on adjustment for positioning. All five of the head restraints rated good are fixed. But fixed restraints as well as adjustable ones have to be well-designed to begin with, and more than half of the fixed ones the Institute evaluated are rated poor because of their geometry.

The Institute's head restraint evaluations are based on two criteria, the first of which is the distance down from the top of an occupant's head to the top of the restraint. A head restraint should be at least as high as the head's center of gravity, which is about 9 centimeters below the top of the head of an average-size male. The second criteria is backset, or the distance from the back of an occupant's head to the front of the restraint. This distance should be small — the smaller the better. Backsets greater than 10 centimeters have been associated with increased symptoms of neck injury in crashes.

Head restraint geometry was measured in relation to a seated, average-size male. Four zones for head restraint geometry were defined based on distance down from the top of the head as well as backset. Each zone represents progressively worse geometry:



A restraint is rated good if its geometry puts it in zone 1 without adjustment; acceptable if it's in zone 1 with adjustment that locks in place or zone 2 without adjustment; zone 2 with locking adj 3 without; and poor if it it in zone 4 regardless

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Some head restrain forward to bring the back of the head. Th wasn't considered in head restraint evalua because it cannot easil whether the tilted po maintained in a crash

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GOOD

- **Honda Civic Del Sol**
- **Porsche 911**
- **Volvo 850**
- **Volvo 940**
- **Volvo 960**

ACCEPTABLE

- BMW 525i
- BMW 540i
- Mercedes E Class
- Mercedes S Class
- Mercedes SL Class
- Mercury Villager
- Nissan Altima
- Saab 900

MARGINAL

- Acura Integra
- BMW 325i
- BMW 740iL
- **BMW 840Ci**
- **BMW M3**
- Cadillac Brougham
- **Chevrolet Corvette**
- Ford Contour
- Geo Prizm
- Honda Accord
- **Honda Civic**
- Honda Odyssey
- **Honda Prelude**
- Hyundai Elantra
- Jaguar XJ6
- Jaguar XJ12
- Lexus ES 300
- Lexus LS 400
- Mazda MPV
- Mazda MX-3
- Mercedes C Class
- Mercury Mystique
- Mitsubishi Eclipse
- Mitsubishi Mirage
- Nissan Maxima
- Nissan Quest
- Pontiac Grand Am 2dr
- Subaru Impreza
- Subaru Legacy
- Suzuki Esteem
- Toyota Camry
- Toyota Corolla
- Toyota MR2
- **Toyota Supra**

POOR

- Acura Legend
- Audi 90
- Audi A6
- Audi Cabriolet
- Audi S6 Quatro
- BMW 318i
- Buick Century
- **Buick Estate Wagon**
- Buick LeSabre
- Buick Park Avenue
- Buick Regal
- Buick Riviera
- Buick Roadmaster
- Buick Skylark
- Cadillac DeVille
- Cadillac Eldorado
- Cadillac Seville
- **Chevrolet Astro**
- Chevrolet Beretta
- **Chevrolet Camaro**
- Chevrolet Caprice
- Chevrolet Cavalier
- Chevrolet Corsica
- Chevrolet Lumina sedan
- Chevrolet Lumina van
- Chevrolet Monte Carlo
- Chrysler Cirrus
- Chrysler Concorde
- Chrysler LeBaron
- Chrysler LHS
- Chrysler New Yorker
- Chrysler Sebring
- Chrysler Town & Country
- Dodge Avenger
- **Dodge Caravan**
- Dodge Intrepid
- Dodge Neon
- Dodge Spirit
- Dodge Stealth
- Dodge Stratus
- **Dodge Viper**
- Eagle Summit
- Eagle Talon
- Eagle Vision
- **Ford Aerostar**
- **Ford Aspire**
- Ford Crown Victoria
- Ford Escort
- Ford Mustang
- **Ford Probe**
- Ford Taurus
- Ford Thunderbird
- Ford Windstar
- **Geo Metro**
- GMC Safari
- Hyundai Accent
- Hyundai Scoupe
- Hyundai Sonata
- Infiniti G20
- Infiniti J30
- Infiniti Q45
- **Jaguar XJS**
- Lexus GS 300
- Lexus SC 300
- Lexus SC 400
- Lincoln Continental
- Lincoln Mark VIII
- Lincoln Town Car
- Mazda 626
- Mazda 929
- Mazda Miata
- Mazda Millenia
- **Mazda MX-6**
- Mazda Protege
- Mercury Cougar
- Mercury Grand Marquis
- Mercury Sable
- Mercury Tracer
- Mitsubishi 3000 GT
- Mitsubishi Diamante
- Mitsubishi Galant
- Nissan 200SX
- Nissan 240SX
- Nissan 300ZX
- Nissan Sentra
- Oldsmobile Achieva
- Oldsmobile Aurora
- Oldsmobile Cutlass Ciera
- Oldsmobile Cutlass Supreme
- Oldsmobile Eighty-Eight
- Oldsmobile Ninety-Eight
- Oldsmobile Silhouette
- Plymouth Acclaim
- Plymouth Grand Voyager
- **Plymouth Neon**
- **Plymouth Voyager**
- Pontiac Bonneville
- Pontiac Firebird
- Pontiac Grand Am 4dr
- Pontiac Grand Prix
- Pontiac Sunfire
- Pontiac Trans Sport
- Saab 9000
- Saturn SC
- Saturn SL
- Saturn SW
- **Suzuki Swift**
- Toyota Avalon
- Toyota Celica
- **Toyota Paseo**
- Toyota Previa
- **Toyota Tercel**
- Volkswagen Cabrio
- Volkswagen Golf
- Volkswagen GTI
- Volkswagen Jetta
- Volkswagen Passat

Notes: Fixed restraints are identified in **bold type**. The best selling model in each 1995 car series was chosen for evaluation. Other models within the same series could come with different seats and head restraint designs. Plus, more than one seating option may be available within a model. For example, the Toyota Previa LE has optional captains' chairs with integrated head restraints. The ratings shown here don't necessarily apply to these designs.

ead Restraints with Good Geometry Can Reduce Neck Injuries

straints in Most Cars Don't Have Good Geometry, Wouldn't Protect Most People in Rear-Enders

lead restraints can be effective against olash injuries in crashes but, for this appen, the restraint itself has to start certain attributes. At a minimum, the t geometry is required before a head raint even has the potential to provide quate protection in rear-end crashes. he best head restraint design is fixed, uires no adjustment, and is high ugh so it's positioned behind and e to the backs of the heads of seated upants whose heights vary widely. ecially poor head restraint designs are stable ones that often are left in their est positions where they cannot possi- protect many vehicle occupants. Even neir highest, or "up," positions, many stable restraints aren't designed so can be positioned to protect many upants. The geometry doesn't allow it.

Good head restraint geometry is neces- but not sufficient for good protec- The relative stiffnesses of the seat k and restraint also help determine ctiveness. Yet so little is known about precise mechanisms of whiplash that amic evaluations of seat back/head raint combinations aren't yet feasible.

How They Can Help: Head restraints be- e mandatory in the right and left front s of all passenger cars made for sale he United States beginning in 1969. In 1, the Institute and State Farm Insur- e evaluated these devices, finding an ercent reduction — 10 percent among es, 22 percent among females — in the orted incidence of neck injury among ers in rear-end collisions.

Research from the National Highway ffic Safety Administration later report- separate neck injury reductions for d and adjustable head restraints in -end crashes — 17 percent for fixed 10 percent for adjustable.

Positioning counts. Researchers in an have reported a significant increase in rearward neck bending motion when a head restraint was left in its lowest, or "down," position. Other studies have found correlations between neck injuries and locations of adjustable head restraints. One Swedish study indicates that injury risk in rear-end crashes goes up with increasing distance down from the top of the head to the top of the restraint. Another indicates that neck injury symptoms last longer the greater the horizontal distance between the head and the restraint.

Most Exhibit Poor Geometry: Head restraints in most cars today aren't designed for potentially effective protection in rear-end crashes. The restraints in only 5 among 164 cars Institute researchers evaluated are rated good (see "How Bad Are They?," p.6). In contrast, the restraints in 117 models are rated poor.

There are really two problems. The geometry of many head restraints is such that they cannot be positioned sufficiently high and close to the backs of occupants' heads, regardless of adjustment. Another problem becomes relevant only if a restraint can be adjusted to provide good geometry — most motorists leave their restraints in the lowest, or "down," position. This means the devices aren't in position to protect most people and could, in some cases, even increase injury potential.

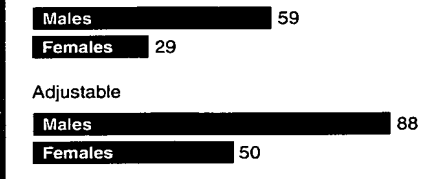
Two recent studies are relevant:

- Studying Institute film of vehicles approaching intersections, researchers at General Motors reported that 83 percent of adjustable head restraints "could have been raised to better protect the driver." The researchers attempted to quantify the increased risk, reporting that the majority of 1,915 drivers were at risk of whiplash "from 1.6 to 6.0 times greater" than drivers whose head restraints put them at the lowest whiplash risk.

- The Institute's own study, based on 1994 videotape of moving vehicles, found that head restraints weren't high enough and/or close enough to the backs of occupants' heads for optimum protection in rear-end crashes in 65 percent of cars with adjustable restraints and nearly half of those with fixed ones. Men are generally taller than women, so their head restraints were more likely to be poorly positioned.

Percent of Drivers with Poorly Positioned Head Restraints

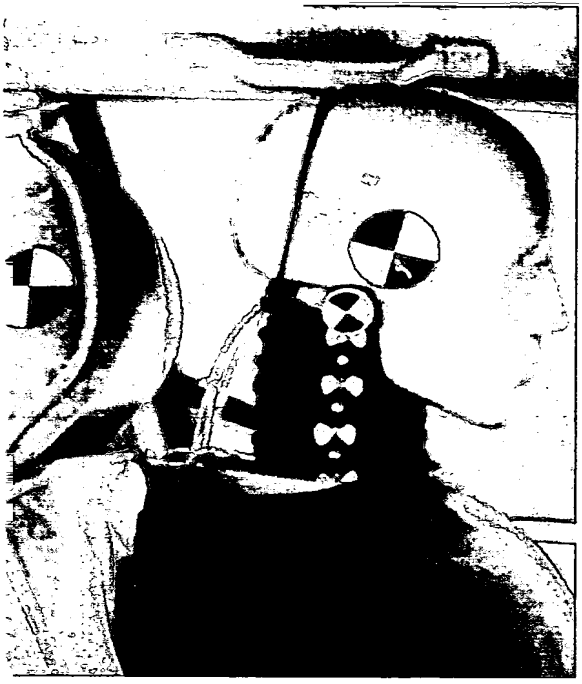
Based on analysis of videotape, 1994

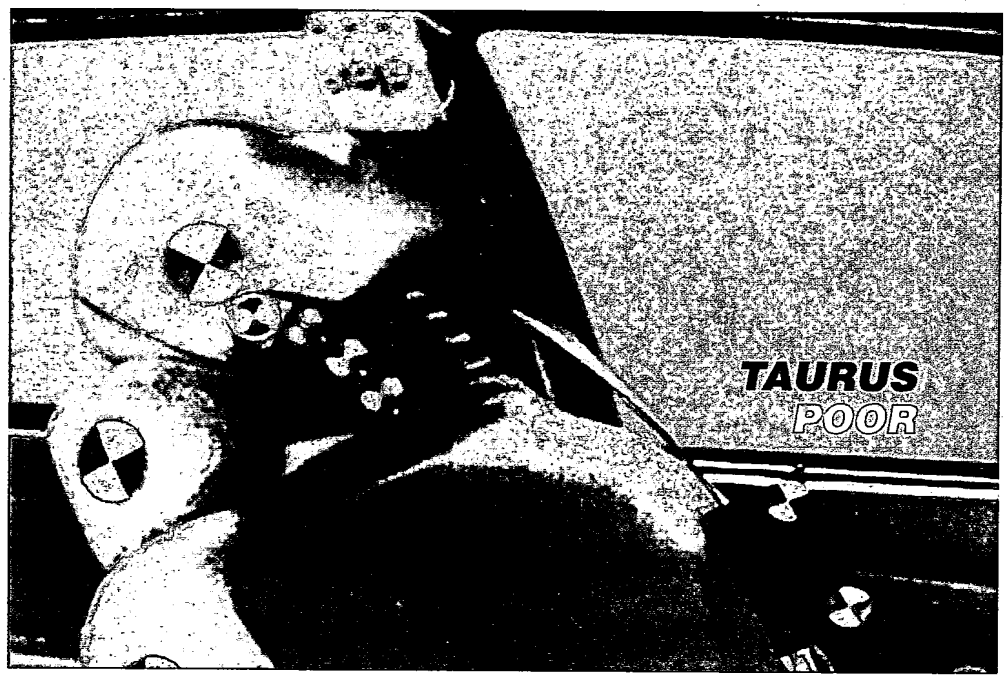


Both studies found that fixed head restraints are more likely than adjustable ones to be positioned correctly for men and women. For the Institute's study as well as the one from General Motors, researchers determined from vehicle profiles the relative heights of head restraints and the gaps between the restraints and the backs of motorists' heads.

Restraint/Seat Back Relationship: Seat back properties as well as head restraint designs affect occupants' head and neck movement in rear-end crashes. The Quebec task force (see "Saving Our Necks in Car Crashes," p.1) reported that vehicle restraints and seat backs often are made of materials with different stiffnesses or energy-absorbing characteristics. This could cause people's torsos to rebound in crashes faster and sooner than their heads, thus worsening neck extension.

A federal proposal in 1974 would have consolidated seat and head restraint standards and tested these items as one. But the proposal was never enacted (see "More than 20 Years Have Elapsed Since NHTSA Proposed Better Head Restraints," p.11).





Good Versus Poor: Crash Tests Show the Difference

Institute crash tests demonstrate the wide difference between a potentially good head restraint and a poor one — that is, one with good geometry and one without. Two cars — a Volvo with a fixed head restraint and a Ford Taurus with an adjustable restraint — were subjected to 10 mph rear impacts from a 4,000 pound moving barrier. The test dummy, whose size represents an average male, has a neck developed by Swedish researchers specifically for rear-end crash testing.

The Volvo's restraint (top) prevented the dummy's head and neck from bending rearward. Contrast this with what happened in the Ford. Its adjustable head restraint, positioned before the crash in its highest mode (above), still wasn't behind the dummy's head and didn't lock in this "up" position. Instead, it was pushed down in the crash, compromising protection. These results illustrate what Institute researchers found when they evaluated the head restraints in 1995 car models. Only 5 cars among 164 are equipped with head restraints rated good (see "How Bad Are They?," p.6). All but one Ford model have restraints rated poor.

What characterizes good head restraint geometry? The height should be such that the restraint is positioned directly behind an occupant's head. The horizontal distance between head and restraint should be very small. And the restraint should be designed to stay in position during impact — that is, not push down or rotate.